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## (54) A device for controlling the feed state of a textile thread supplied to a weaving machine.

(57) This invention relates to a device for controlling the feed or stop state of one or more textile threads supplied to a weaving machine, by emission of an electric signal which is indicative of the thread movement state. The device comprises a member for converting the mechanical stresses produced thereon by the thread in electric signals, the latter being supplied to an electronic circuit in which such signals are first amplified, then integrated and compared with a reference voltage and finally sent to an actuating circuit emitting an electric signal, as a function of the thread movement state, which can be supplied to an alarm or control device for the machine movement.

In turn, the above mentioned member comprises a diapason, between the prongs of which a magneto-dynamic element or an element of piezoelectric material or the like is restrained, which converts in electric signal the vibrations amplified by the diapason and generated thereon by the thread running on the diapason prongs, adjacent the base thereof, remote from said element.

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# A DEVICE FOR CONTROLLING THE FEED STATE OF A TEXTILE THREAD SUPPLIED TO A WEAVING MACHINE

This invention is concerned with an electronic device for controlling the feed state of a textile thread supplied to a weaving machine, and more particularly a device for sensing the movement or stop state of the thread by emitting a signal capable of operating an alarm device and causing the machine to stop in case of breakage or wantage of the supplied thread.

As well known, textile threads as continuously or discontinuously supplied to weaving machines may be subjected to breakages or stops of the supply thereof due to any kind of failures. Such a drawback has been hitherto obviated by using so-called "thread fall" devices comprising rocking arms against the action of a spring urging such arms on the thread, constantly sensing the tension thereof and accordingly signalling any reduction in such a tension, indicative of the thread breakage or wantage. Practically, these known devices require an accurate calibration for each type of thread, frequent maintenance and have the most serious drawback to cause napping formation due to the thread passage on the control device, which by occluding the thread guide holes, through which a thread would pass, will cause the breakage of the latter; in such a case, the thread would remain embedded in the small hole, whereby the tension applied to the rocking arm would not be reduced and accordingly no signal is given for the supply stop with evident damages to the produced fabric.

Devices suitable to check yarn travel along a path in a textile machine are disclosed in U.S. patent nº 3,361,314 and nº 3,688,958 and in the Bristish patent application nº2023671 A: these devices include a sensing element localed adjacent the yarn travel and connected with a piezo-eletric pickup or the like suitable to generate electric signals in response to the friction and oscillation of the moving yarn. The piezo-electric pickup is connected to an electronic circuit filtering and amplifying the signal produced by the sensing element: the so amplified electric signal is supplied to an alarm or control apparatus for the machine movement. In these known devices the sensing element consists of a rigid shaped body which is made integral with the piezo-electric pickup or which includes a movable body portion which is oscillatable by the traveling yarn engaging it . As consequence of such a structure these known devices have a low sensitivity and reliability in operation; morecver they can hardly be isolated from the machine frame in order not to be influenced by the frame vibriations and they are markedly sensible to jerks of the running yarn . Finally, known devices of the above referred type are suitable to check the movement of a single yarn at a time.

It is the primary object of the present invention to provide a device of high efficiency and easy and ready installation, adapted for any weaving machine, and particularly capable of signalling with great rapidity the conditions of drawing or stop for the thread being supplied to the weaving machine.

It is another object of the invention to provide a device based on electronic circuits and sensing members or elements for the thread presence, such as to allow an extremely sensitive and effective control of the thread movement state, removing all of the drawbacks inherent to similar devices at present known.

It is still a further object of the invention to provide a device for simultaneously controlling a plurality of distinct textile threads, of which only one at a time can be drawn from the weaving machine, such threads being at the same time counted by the sensing member of the device.

Such objects are achieved by a device for controlling the feed or stop state of a textile thread supplied to a weaving machine or the like, comprising sensor means for sensing the thread slide, adapted to convert the mechanical stresses produced thereon by the thread slide or running in an electric signal having voltage and frequency characteristics depending on said stresses, an amplifying circuit having said electric signal applied thereto, an integrating circuit for the values of said amplified electric signal, a comparing circuit for said signal as integrated with a reference voltage, and an actuating circuit

controlled by said integrated and compared voltage and adapted to emit an electric signal, as a function of the feed or stop state of said thread,, capable of operating an alarm device and/or causing the machine movement or stop control, characterized by comprising a feeler element in contact with said thread, such an element comprising a diapason, of which the prongs are restrained to said sensor.

In order that the structure and features of a device according to the invention be more clearly understood, an embodiment thereof will now be described by way of unrestrictive example, with reference to the accompanying drawings, in which:

Fig. 1 is a perspective view of the device;

Fig. 2 is a block diagram for the electronic circuits forming the electric portion of the device; and

Fig. 3 is a detail view showing the various electronic circuits, as functionally associated with one another, according to the individual blocks shown in the diagram of Fig. 2.

Referring to Fig. 1, a device according to the invention comprises a box-like body 1, in which the electronic circuit shown in Figs. 2 and 3 is enclosed or embedded within a resin. The base of said body 1 has secured thereto a diapason 2 having two parallel prongs, the cantilever projecting base of which is partly downward bent or arcuated to form a sliding saddle for a thread 3 drawn from a supply source (reel or bobbin or the like) and supplied to a weaving machine. The ends of the diapason prongs are restrained

on a sensor 4 (Fig. 2) within said body, the function of which will be discussed in the following. From said body 1 there also projects a rocking bow or fork 5 having the opposite portion to the hinging or pivoting portion partially arcuated in opposite direction to that of the diapason base. Said fork 5 is opposite to a preloaded spring for maintaining it upward raised in order to retain the thread between the diapason saddle and that of said fork. The fork spring can be calibrated by a loading screw 6 and an adjustment index 7, so that in case of tearing at the reel or jerk or even anomalous enlargement in the thread, the latter can become clear of the slide saddles, and thereby the device can stop the machine for wantage of thread in contact with the diapason, as better explained in the following.

Said body 1 has also provided thereon a side bracket 8 with relative clamping screw 50 for use in securing such a body 1 to a weaving machine. A light diode 9 is also provided on said body 1, the lighting of which indicates the thread movement stop, and a connector 10 having four metal pins for electric connection.

A preferred practical embodiment of the circuits forming part of the device is shown in the block diagram of Fig. 2 and in detail in Fig. 3, wherein character reference R denotes resistances, C capacitors and D diodes, while symbol IC1 denotes an operational amplifying circuit, IC2 a stabilizing integrated circuit, T1 a transistor and LD1 a LED (diode emitting light).

Further examining said diagram, it will be seen that the sensor-preamplifier block a comprises a sensor 4, which may be of magneto-dynamic type or formed of a piezoelectric material such as quartz or the like, capable of sensing the oscillations of the diapason, the prongs of which (Fig. 2) are restrained to the sensor. As urged by the thread, the diapason starts to oscillate transmitting to the tips of the prongs thereof said ocillations as considerably amplified and such as to urge the sensor which, in turn, converts these mechanical oscillations in an electric signal which, as suitably preamplified and frequency filtered is supplied to the next oircuit b which, in turn, provides for a further and final amplification and selection of the signals at a desired frequency, which are thus enabled to each the circuit of block c. The latter, which is an integrating circuit, converts the signals in a voltage level which will increase as the frequency and amplitude thereof increase. This voltage is then applied to the input of block d, the comparing circuit of whioh compares said voltage level with a reference voltage supplied by block e, thus signalling whether the voltage level being examined is higher or lower than that of the reference voltage. Thus, if the signal frequency and amplitude is sufficient to obtain from block c a higher voltage level than that of the reference voltage, the circuit will not provide for emitting an alarm signal and will keep the relay RL1 on. On the other hand, should such a level be lower, said relay would release and the alarm lamp 9 (diode LD1)

will light up signalling, for example, a machine stop provided by said relay.

Since the textile threads to be controlled on a single machine are generally in a great number, when the machine has been stopped, the problem arises to find out which of the many devices installed on the machine has caused the stop. This problem is solved by interlocking "in passing" all of the devices, that is providing a proper signal at the relay input or pin designated at 31 in Figs. 2 and 3. The first device causing the alarm operates its own alarm lamp 9 and by means of a central control locks the other devices, stopping the machine and thus making it easy to identify that device in connection with which the thread breakage has occurred.

The input and output terminals of connector 10, denoted at 11 and 41, respectively correspond to the common and normally closed contact of the actuator relay RL1 which causes the machine stop.

The terminals 21 and 11 respectively represent the supply positive and negative pole of the device, of which said pole 21 is connected to block e, while pole 11 is direct and common to the entire circuit.

For a still further clearness, the electric cirouit will now be explained in further detail.

However, a description is first given about the importance of the diapason, which is the first element of the cirouit and enables to provide such a sensitivity and reliability in operation

that cannot be obtained with other systems. Thus, as shown in Fig. 1, the thread slide on the diapason base produces mechanical stresses at the prong base of the diapason, converted by the latter in oscillations, which as considerably amplified can be drawn on the tips of said prongs.

The function of the diapason provides the device with a considerable sensitivity and owing to its mechanical shape allows such a mounting as to acoustically insulate it from the body or container 1, thus enabling the electronic circuit to sense and then amplify only the diapason vibrations (due to the thread passage) and not any other vibrations, thereby permitting a considerable increase in circuit amplification, further improving the apparatus sensitivity. It is another important feature of this diapason the reliable sensing of the thread or yarn slide also during considerable tearings and jerks of the running thread. This because, even when moving away from one prong,the thread would run on the opposite prong without any loss of sensitivity owing to the nature of the diapason allowing the transfer of an oscillation from one to the other prong.

It is also known that a diapason may be shaped according to different shapes, whereby the shape thereof can be adapted to the control requirement to be effected. For example, the diapason 2 may have the shape shown in Figs. 1 and 2 where a single thread has to be controlled, or may be differently shaped to accomodate the control of a plurality of textile threads (for example 4 threads)

as required, for example, when the machine on which the apparatus is mounted is a so-called "ruling or scoring" type of weaving machine, in which each fall has four threads of different colours, of which only one at a time is supplied to the machine.

In the exemplary embodiment shown in Fig. 3, the block a comprises a sensor and a circuit acting both as a filter and as a preamplifier, of which the former may be represented by a magneto-dynamic sensor of the type as used, for example, in the manufacture of microphones or magnetic phongrafic heads, or by a material, such as quartz, piezoelectric, since both of such systems would provide the same result, although with not identical electric characteristics. On the other hand, the electronic circuit through the resistive net comprising the resistors R1, R2, R3 and R4 and the transistor T1 is a normal amplifying circuit of "class A" which, owing to the capacitor C2, enables to provide a high amplification for a range of involved frequencies, and this because such a capacitance, for an electric signal having a higher frequency than the predetermined frequency, reduces its own reactance from a limi close to "infinite" to a value close to "zero".

In input capacitance C de-couples the continuous component of the amplifying circuit from the sensor, and the output signal at the circuit and accordingly at block a is drawn by the collector of said transistor T1 through the capacitance C1 of block b, comprising a further and final amplifying stage of the same frequency range as selected by said block a. Such a stage is

represented by an operational amplifying circuit which, through the network of resistances and capacitors comprising R6, R7, R8 and C3 acts as an active filter capable not only of selecting the involved frequencies, but also amplifying the latter.

On the other hand, the resistance R7 serves for la polarization of the amplifier OP.

The capacitor C1 and resistance R5 at the input to the active filter operate as passive filter increasing, together with the circuit of block a, which is also an active filter, and the operational amplifier, the slope of the entire system for the selection and amplification of the frequencies of the electric signal.

The block c is an integrating circuit which through the de-coupling capacitance C4 draws the signal as hitherto processed and places it at one end of the polarization resistance R9 and at the anode of diode D4, which de-couples the integrating capacitance C6.

The resistance R11 assures the disoharge of the integrated voltage level in case of instantaneous or gradual blocking of the signal and, if required, also determines through the time constant $R_{11}$-$C_6$, some delay to the operation of the alarm signal and resulting de-energization of the relay RL1. The attained voltage level, placed at one end of capacitor C6, is sensed by the second half of the operational amplifier IC1 through the inverting input. The reference to such a level is placed instead

at the not inverting input and is supplied by the voltage division carried out by the resistances R10-R12 and R13, which together with the operational amplifier form a classic circuit, commonly referred to as Smith's trigger.

When the positive voltage level, integrated by C6, is higher than the reference level, the output of the operational amplifier will be negative; on the other hand, when such a level is negative relative to reference, the output will be positive. If negative, the output of the operational amplifier will supply the relay RL1 through the directly polarized diode D3 and resistance R15, but when positive, said diode D3 will be inversely polarized and will not supply said relay RL1. The resistance R15 and capacitor C7 only serve to limit the consumption of relay RL1 when energized by the pulse provided from C7, at the end of which the resistance R15 will maintain said relay at attracted state, supplying it with a slightly higher voltage than the release voltage of the relay.

The resistance R14 and diode D2 are used for providing the inhibition input of relay RL1; thus, should the ground potential be placed at the pin-input 31 of the circuit, the diode D2 is directly polarized and together with said resistance R14 will maintain said relay RL1 energized (even when the machine is stopped) and the voltage on the cathode of diode D3 (output of IC1) should become positive. In case of de-energized relay, that is under alarm condition, the current to the LED diode LD1 is supplied by the resistance R16 connected to the output of the

operational amplifier IC1. The stabilized positive supply is provided by the integrated stabilizer IC2. The matter provides for adjusting the positive voltage applied to the connector pole 21 which, overcome the de-coupling diode D1 among a plurality of devices and being only rectified, is levelled by C8 and applied to the input of IC2; therefore, at the output of the latter there will be provided the stabilized voltage supplying both the integrated circuit IC1, and the selective preamplifier of block a, and the relay RL1.

The circuit of Fig. 3 may be implemented by components having the following values: R1 = 220 Kohms; R2, R3, R4, R5, R9, R10 and R13 = 100 Kohms; R6 and R8 = 1 Mohm; R7 = 470 Kohms; R12 = 4.7 Kohms; R14, R15 and R16 = 2.2 Kohms; C1, C2 and C6 = 10 /uF; C3 and C4 = 1 /uF; C5 and C7 = 10 /uF; C8 = 100 /uF, 50 V; D1, D2, D3 and D4 = 1N4148; the integrated circuit IC1 manufactured by Fairchild is marketed as /uA798TC; the integrated circuit IC2 is marketed as 78L24AWC; and the transistor TR1 is of BC108C type.

The embodiment of the electronic circuit above detailedly described with reference to Figs. 2 and 3 is given merely by way of example. Indeed said circuit may be different from that one which has been so exemplified : for instance, it might be made in accordance with the teachings of the U.S. patents nº 3,361,314 and nº 3,688,958 or of the British patent application nº 2023671 A.

From the foregoing it will be readily seen that the control device according to the invention eliminates any drawback in supply, since the control is effective on the thread movement and not on the tension thereof it is obviously apparent that the formation of slubbing or any other drawback would not affect the stop reliabili of the electronic circuit. Therefore, it clearly appears that the simplicity and versatility of the described device allows the use thereof on any type of weaving machine where it is required to control the start, run or stop of a thread supplied to the machine.

Obviously, further modifications and changes both of structural and functional nature can be made to the above described device without departing from the protective scope of the present invention.

CLAIMS

1. A device for controlling the feed or stop state of a textile thread supplied to a weaving machine or the like, comprising a detector for sensing the thread slide and adapted to convert the mechanical stresses thereon produced by the thread slide in an electric signal having voltage and frequency characteristics depending on said stresses, an amplifying circuit to which said electric signal is supplied, an integrating circuit for the values of said amplified electric signal, a comparing circuit of said integrated signal with a reference voltage, and an actuating circuit controlled by said integrated compared voltage for emitting an electric signal, as a function of the feed or stop state of said thread, capable of operating an alarm device and/or determining the machine movement or stop control, characterized by comprising a feeler element in contact with the thread, said element being formed of a diapason, the prongs of which are restrained to said sensor.

2. A device as claimed in Claim 1, characterized in that at least one of the prongs of said diapason, at a position close to the diapason base and remote from said sensor, has at least a portion thereof in the shape of an arc to form a slide and retain saddle for the thread.

3. A device as claimed in Claim 2, characterized in that both of the diapason prongs have said arc-shaped portion.

4. A device as olaimed in Claims 1 to 3, oharacterized in that said sensor is restrained to the free ends of the prongs of said diapason.

5. A device as claimed in Claims 2 to 4, characterized in that said diapason has oppositedly mounted thereon at least one bow or fork oscillating against the action of calibratable springs, which slightly presses said thread on the saddle-shaped portion of the diapason.

6. A device as claimed in Claims 1 to 5, characterized in that said sensor, restrained to the diapason prongs, comprises a magneto-dynamio element, piezoelectrio material or the like.

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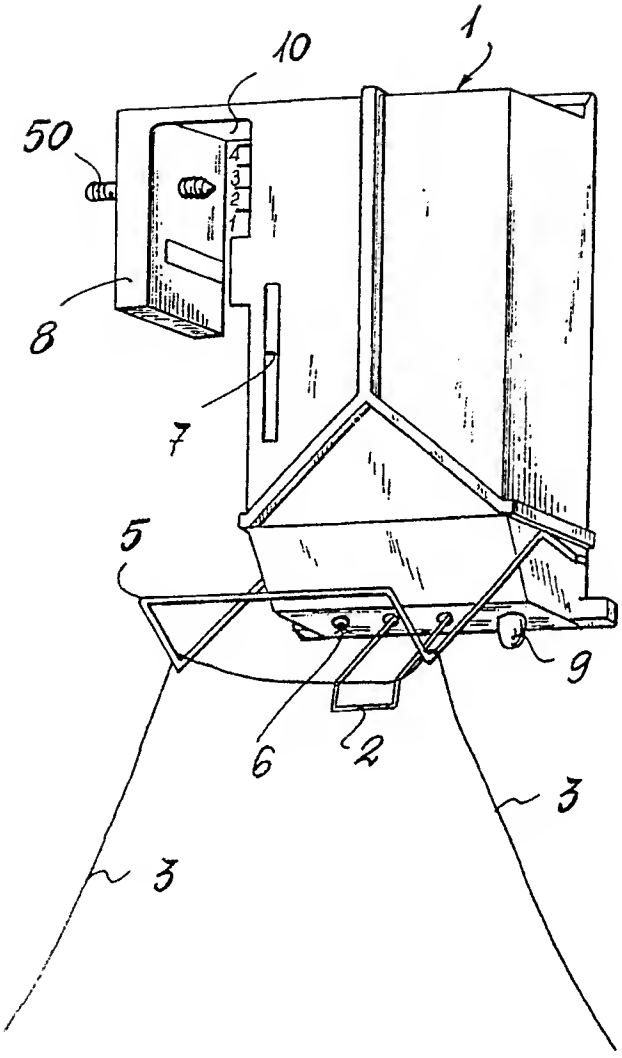


Fig. 1

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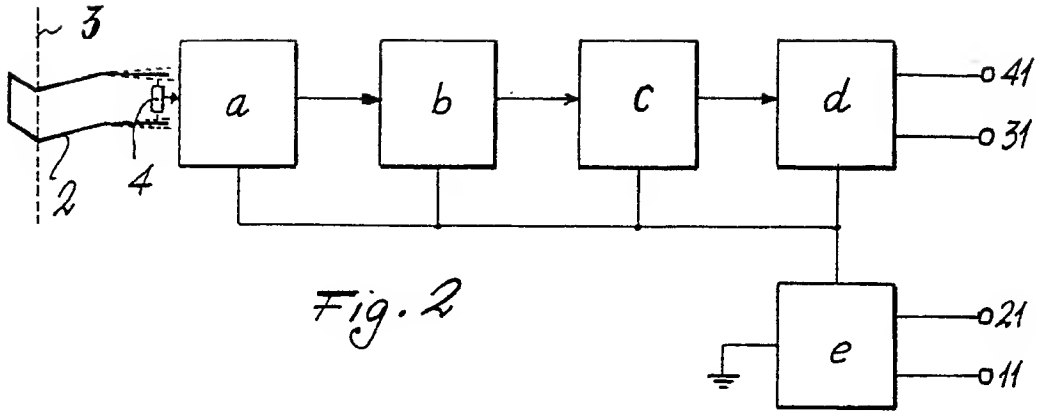


Fig. 2

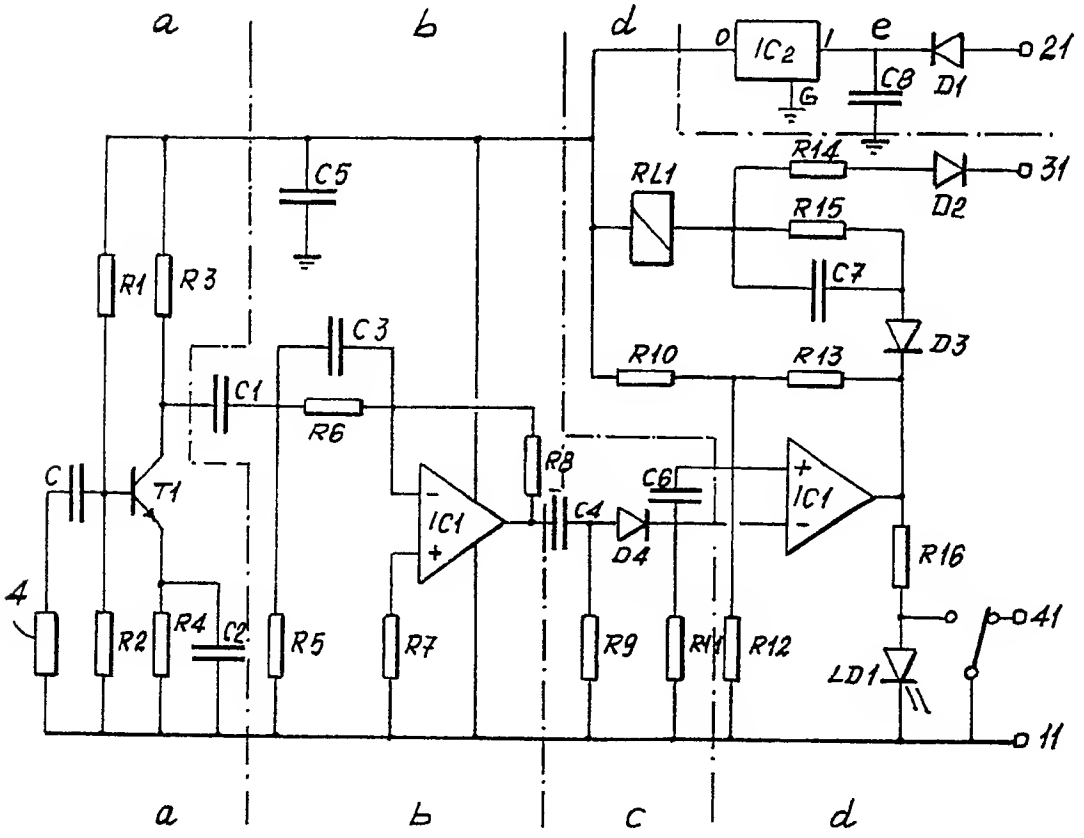


Fig. 3

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European Patent Office

Application number

EP 84 20 0105

# EUROPEAN SEARCH REPORT

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Ralevant to claim | CLASSIFICATION OF THE APPLICATION (Int. Cl. ³) |
|---|---|---|---|
| A,D | GB-A-2 023 671 (SHINZO KITAMURA) | | D 03 D 51/34<br>B 65 H 63/02<br>G 01 H 13/00 |
| A | FR-A-1 443 549 (W. REINERS)<br>& US - A - 3361314 (Cat. D) | | |
| A | US-A-2 928 308 (THE ATLANTIC REFINING CO.) | | |
| A,D | US-A-3 688 958 (STEN-AKE RYDBORN) | | |

TECHNICAL FIELDS SEARCHED (Int. Cl. ³)

B 65 H
D 03 D
G 01 D
G 01 H
G 01 B

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 28-05-1984 | DEPRUN M. |

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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